

# **ANALYSIS OF ROADMAPS AND TRENDS FOR MOBILE COMMUNICATION TECHNOLOGY IN THAILAND**

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## **ABSTRACT**

*Mobile communication technology has been undergoing an extraordinarily fast evolution in the history. Mobile business is the new business designs that not only connect people, but also connect people and business with Internet and things to drive revenue and create opportunity. In Thailand, mobile networks continue to witness exponential growth in data traffic; thereby fourth generation wireless technology has been anticipated for the consumer demand. To understand the evolutionary changes in mobile technology and services in Thailand, this research aims to describe roadmaps and trends for mobile communication technology. Qualitative research method is adopted where a variety of credible secondary sources are applied in this research focusing on evidence-based approach. A guideline for development of roadmap for spectrum management is presented in this research. This paper is also provides spectrum roadmaps for mobile services in 1800 MHz, 700 MHz, 2600 MHz, and unlicensed band.*

**Key word Head:** Analysis, Mobile, Roadmap, Thailand, Trend

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## **1. INTRODUCTION**

The mobile telecommunications technology is getting so rapidly advanced since the popularity of mobile data services has grown worldwide. All providers of mobile telecommunications network services or mobile operators have continuously given importance to making investments in new technologies in order to supply the demand for network utilization. Furthermore, the modern technologies which have entered into the market since the year 2000 are able to fulfill business needs in terms of

reducing installation time, costs, CAPEX of installation as well as increase network efficiency in terms of overall service provision. Besides, those network devices are of a compact size appropriate for enabling faster transportation and installation compared with the telecommunications technologies in the first period of the digital age.

The mobile operators' concept of mobile network investments during the past 10 years has affected the strategies for investment and management to be changed significantly, both in terms of networking techniques and income management (through marketing approaches). This includes the transformation from the investment strategy which was based on a macro-only network or a homogeneous network to hybrid network solutions. The latter is also known as a heterogeneous network (HetNet) comprising the same old macro cells plus small cells and Wi-Fi networks to increase the efficiency of services and to complement one another, both in the aspects of network coverage and bandwidth adequacy to ensure service continuity. Nowadays, the telecommunications market strategy adopted by several countries focuses on the use of Wi-Fi networks to complement the core network so as to reduce the demands for data consumption and network congestion in some service locations. A well-known example of such service in Thailand is the provision of mobile Internet services along as Wi-Fi hotspot networks, also known as 3G/ Wi-Fi Offloading [1].

In Thailand, the National Broadcasting and Telecommunications Commission (NBTC) granted 900 MHz and 1800 MHz spectrum licenses for the 4G LTE technology by way of spectrum auction in the end of the year 2015. The licensing of both spectrum bands can be considered as the first transition of the telecommunications industry from concessions to licensing regime in Thailand. In granting the spectrum licenses for telecommunications service by auctioning, the NBTC strives to achieve the regulatory balance composing of the most efficiency of spectrum assignment, free and fair competition, and state benefits, in order to bring about the greatest benefits to the people and the country. While the technology transition after the auctioning will directly benefit the telecommunication and ICT businesses, it will also provide further positive impact on the economy on top of the spectrum fee revenue from the auctions [2].

## **2. DEVELOPMENT OF MOBILE SERVICES IN THAILAND**

LTE, a wireless connection that allows faster speeds of data download, is seen as key growth driver for Thai mobile operators. After winning a license for 4G spectrum in an auction in November 2015, AIS, first-ranked mobile operator, spent 14.5 billion baht on installing 7,000 base stations within two months as it accelerates network rollout to compete with competitors. The company aims to expand 4G coverage to 72 provinces by May 2016. AIS has 38 million subscribers, of which more than 20 million surfed Internet via mobiles.

Third-ranked mobile operator True Move is spending 56 billion baht this year to launch the country's first LTE Advanced network or 4.5G to cover 97% of the population. True Move's network will offer dual-band coverage nationwide on the 900 MHz and 1800 MHz spectrum. The company plans to install 13,500 LTE Advanced base stations on the 900MHz network to provide high-speed wireless broadband service in provinces and rural areas. Another 3,000 to 4,000 base stations on the 1800MHz network will be added to provide service in Bangkok and major provinces. True Move holds a combined 55MHz of bandwidth on various spectra consisting of 15MHz on the 2100MHz spectrum, 15MHz on the 850MHz spectrum,

15MHz of 1800MHz and 10MHz of the 900MHz spectrum. the commercialization of LTE Advanced, True Move expects to add other diverse mobile value-added services. The company wants to double its 4G subscribers to 4 million this year.

The National Broadcasting and Telecommunications Commission (NBTC) projects the number of mobile subscribers will exceed 170 million in 2016, up from 100 million this year (2015). Mobile phone penetration in Thailand will grow 3-4 times by 2020, driven by the emerging Internet of Things (IoT) technology that will be deployed in various sectors, especially education, telemedicine, logistics and security [3].

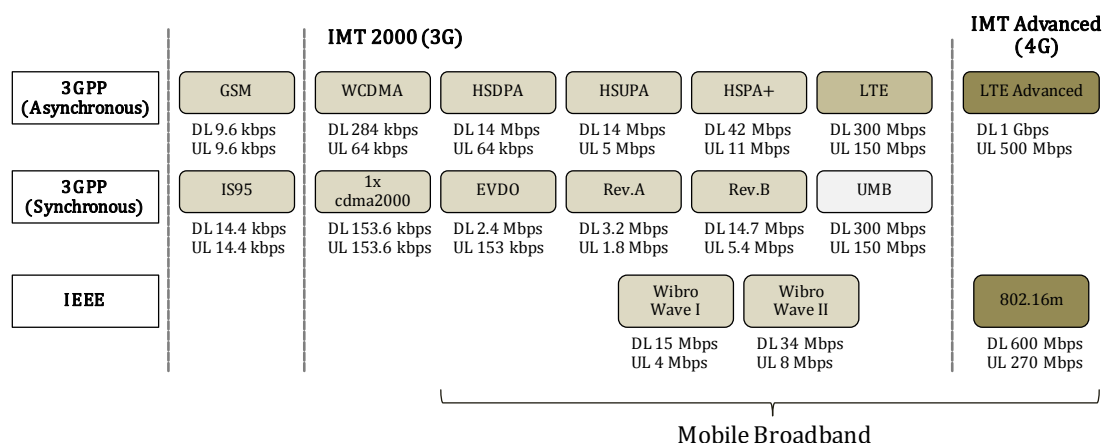
Mobile operators need more bandwidth to serve growing bandwidth-intensive services, fuelled by the proliferation of smartphones and faster speed of wireless broadband networks. Having a variety of mobile spectrum bands (lower and higher 1GHz bands) will enable them to greatly manage frequencies and data traffic flows covering all requirements [4], [5].

Spectrum auctions and technology transitions to 4G will increase industry innovation and competitiveness and will directly and indirectly benefit Thailand's economy in the long term. The improved data rate and enhanced bandwidth on a 4G network are expected to add more subscriber experience and contribute to higher data traffic via rich communication services and more data intensive applications.

The technology transition from 3G to 4G and technology utilization in other related businesses will require large scale network investment that will benefit installation service providers and suppliers. Very aggressive spending on 4G roll-out networks would boost private investment and support the government's vision for a digital economy. The country's benefits come in the form of revenues from the spectrum auction and business operation taxes, as well as the socio- economic benefits and the development brought about by the spectrum utilization [6]. The supportive policy environment could increase fixed and mobile broadband penetration from 52% in 2013 to 133% in 2020, leading to a cumulative GDP increase of USD23 billion (THB730 billion) [7].

### **3. ROADMAPS FOR MOBILE TELECOMMUNICATIONS TECHNOLOGY**

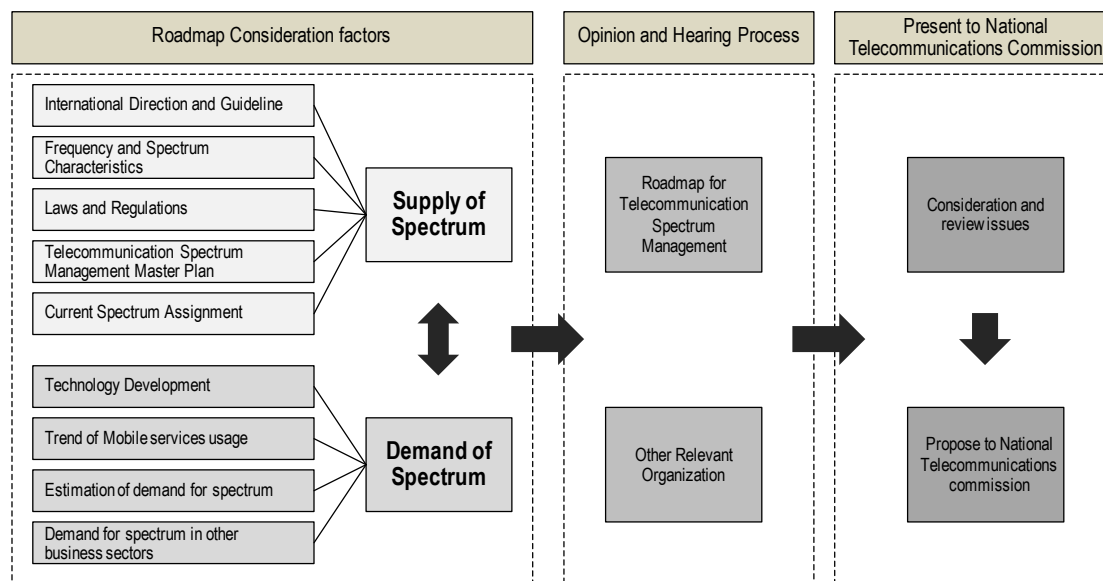
When considering the trends in markets and data communication networks in the telecommunications industry, we should place importance on all servicing mobile communication technologies during extensive periods, from the past up to the present, along as the technologies to be applied in the near future. Nowadays, all mobile operators in several ASEAN countries have transformed themselves into the 4th generation service providers characterized by the 4G Long Term Evolution Technology (4G LTE) with different frequency bands in use. The speed provided for mobile communication services in this region during the 4th generation (4G LTE) will have been completely close to 100 Mbps (based on 12.5-20 MHz bands) by the end of 2018, whereas the trend in services provided through WiMax and WiBro technologies in this regional market is still indiscernible. Fig. 1 shows the generations of mobile telecommunications technology.



**Figure 1** Generations of Mobile Telecommunications Technology

For the estimation of demand for spectrum, apart from data collection and comparison study from foreign country, the result from the discussion with the mobile service providers is also being taken into consideration to the roadmap as it demonstrates the increasing trend of demand for spectrum which is in line with global direction. Therefore the result from the discussion is not the only source used to establish this roadmap [8].

In Thailand, roadmap establishment framework can be classified into 3 steps. From the Figure 2, each step is detailed as follows:



**Figure 2** Step of development for Roadmap for Spectrum Management [8]

### 3.1. Step of roadmap development

This roadmap is developed by the subcommittee of the Roadmap for Telecommunications Spectrum Licensing, appointed by the NBTC. In the process of setting up the roadmap, the subcommittee will consider various factors by classifying them into 2 groups. These are factors relating to the supply of spectrum and demand for spectrum.

A) The group of supply of spectrum consists of various frameworks which relate with allocated spectrums that can be assigned for Telecommunications services;

Framework of Spectrum Assignment Consideration. The frameworks are described as followings;

- (A1) Policy of spectrum management according to International guideline
- (A2) Present spectrum characteristics and technology
- (A3) Thai law and relating regulations
- (A4) Telecommunication spectrum management master plan
- (A5) Assignment of spectrum for telecommunications service

B) The group of demand for spectrum consists of various factors, driving the demand; Driving Factors to the Spectrum Utilization. The considered factors are as followings;

- (B1) Development of technology
- (B2) Trend of Mobile service usage, number of subscribers and the growth of mobile data traffic
- (B3) Estimation of demand for spectrum
- (B4) Demand for spectrum in other business sectors

Information from both Supply of spectrum and Demand for spectrum will be considered in outlining of the roadmap of Telecommunications Spectrum in various bands. The roadmap demonstrates the possible use of the bands with present usage and possibility to use, as well as, demonstrates the recommendation and management process of various spectrum bands.

### **3.2. Step of focus group workshop**

Prepared by the Subcommittee, the Roadmap of Telecommunications Spectrum Management for Thailand has passed the step of discussion, exchanging view with relating focus groups in a workshop under the topic of “the Roadmap of Telecommunications Spectrum Management for Thailand”. There are participants from many organizations; which are:

- Government service organization
- Mobile service providers, manufacturer, and application developer
- Educational sector and relating various professional sectors
- Public sector and organization

The suggestion from the focus group workshop will be used for the roadmap adjustment in order to ensure all aspects are considered and completed before propose to Telecommunication Committee for its consideration.

### **3.2. Step of Telecommunication Committee Consideration**

This proposal will be submitted to the Telecommunications Committee for consideration and approval. If the proposal is accepted by the committee, the subcommittee will conduct the public hearing in the next step.

## **4. ROADMAP FOR THE USE OF SPECTRUM FOR TELECOMMUNICATIONS SERVICE IN THAILAND FOR 5 YEARS**

When considering the existing status and assignment of spectrum and its demand, it shows that the utilization of spectrum currently in use probably needs to be

reconsidered to increase its efficiency and serve such demand more appropriately. Therefore, this paper has studied, analyzed demand for utilization of spectrum, and assigned spectrum to ensure that spectrum management activity will be conducted appropriately with right technology development and in accordance with demand for spectrum bands. The paper has considered principles and roadmaps for spectrum assignment as follows:

- **Bandwidth Sufficiency:** In order to serve growth of Internet users on wireless communication networks, continuous rise in using applications and new services.
- **Coverage and Capacity:** Licensing to deploy proper spectrum bands for both coverage band and capacity band will help maximize potential of the use of radio spectrum and fit to demand of the market.
- **International Harmonization:** To consider licensing any radio spectrum for use, international harmonization has to be taken into account. Harmonized actions make communication devices compatible with others internationally. This will also help reduce the price of wireless communication devices.
- **Timeliness:** Presently use of internet through wireless communication networks – on mobile phones, smartphones, tablets, and portable PCs – is growing dramatically. Therefore, timely licensing for the use of radio spectrum in line with the market development will help licensees able to prepare their readiness – in terms of getting source of fund for investment, business operations, and responding to the demand for internet and other services in timely and appropriate manner.

Frequency bands that need to be considered, and improved their utilization to serve the high-speed wireless broadband service are categorized into four frequency bands as the followings [9]:

## 1. Frequency Band in 1800 MHz

### *a. Consideration from the frequency allocation by ITU*

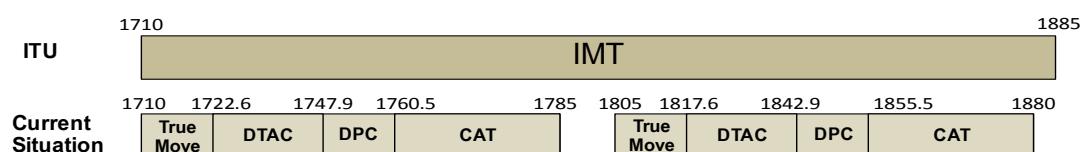
ITU has set the frequency band 1710-1885 MHz for International Mobile Telecommunications (IMT) following the agreement 223 (Rev.WRC-07). This allocation does not prohibit other services from using the abovementioned frequency band. In addition, it does not indicate any prioritization of the spectrum in the Radio Regulation (WRC-07).

### *b. Current Situation*

The spectrum master plan has already set the bands 1710-1785 MHz and 1805-1880 MHz for Telecommunication service and assigned for Mobile service. The concession contracts of some service providers have already expired. Some of them are going to expire. Therefore, preparation for the auction of new assignment of the spectrum has to be done.

### *c. Proposal for Improvement*

None. Maintain the same utilization of the spectrum as it is.



**Figure 3** 1800 MHz allocation by ITU and current situation in Thailand [8]

## **2. Frequency Band in 700 MHz**

### ***a. Consideration from the frequency allocation by ITU and APT***

According to the meeting WRC 12, there was a proposal to use the frequency band 694-790 MHz for IMT. It shall be effective from 2015. Asia Pacific Telecom (APT) has proposed a plan to use the frequency band 700 MHz, in accordance with the report APT/AWF/REP-14 regarding frequency plan of the band 698-806 MHz (Harmonized Frequency Arrangements for the Band 698-806 MHz), recommending the member countries to use the band 700 MHz for IMT, making many countries in the Asia and Pacific regions plan to use 700 MHz.

### ***b. Current Situation***

The spectrum master plan sets the band 510-790 MHz for the radio broadcasting and the terrestrial TV services. The NBTC has announced the change of the terrestrial TV from analog system to digital system, resulting in higher number of business service content channels increased from 6 to 24 channels. The auction for those program channels was conducted on 26-28 December 2013. Those channels are estimated to be on air from mid of 2014 onwards.

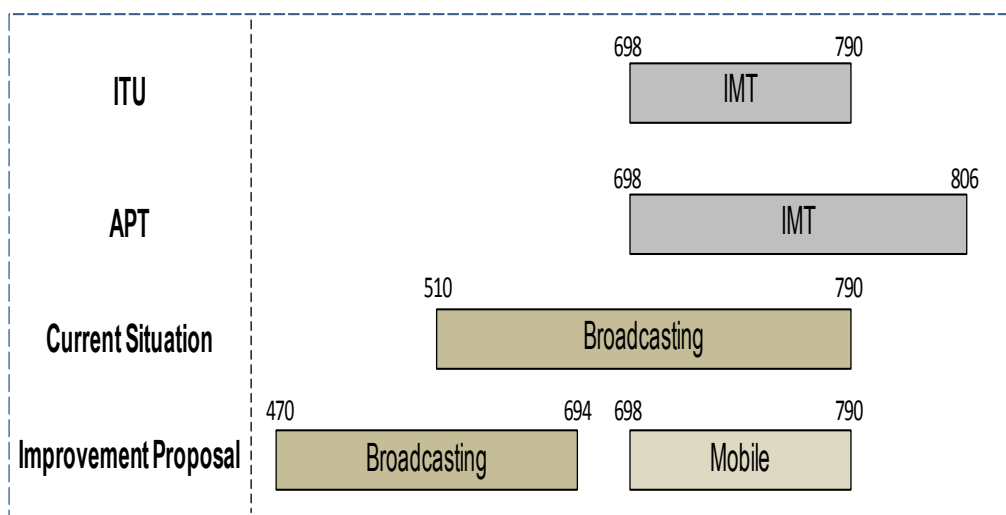
### ***c. Main Factors Effecting the Utilization***

The frequency band 700 MHz -- lower than 1000 MHz -- can propagate in a wide area of coverage. It is most likely interested by operators -- both the existing ones and new comers -- because it needs lower investment on network construction. As a matter of fact, allocation of frequency band in Thailand differs from that in other countries. Although, the television system in Thailand is going to change from terrestrial to digital, there may not be any spectrum left unused, so-called "Digital Dividend", and can be used for IMT service.

The frequency band 700 MHz has been pushed by our neighboring countries -- Malaysia, Singapore, Indonesia, Laos, Vietnam, and Brunei -- as well as by the international forums, e.g. ITU, APT, or ASEAN, and etc., for high-speed wireless broadband service. This makes the utilization of spectrum in Thailand not be in line with that in the Asia & Pacific countries and in the international level. In the long run, it may cause interference problems along the border in case our neighboring countries use such a frequency band for IMT service.

### ***d. Proposal for Improvement***

Propose to shift up the frequency band for the broadcasting service, set the frequency 470-694 MHz for the television service and the frequency 698-806 for the mobile service in order to be in line with most of the countries in the Asia and Pacific region and solve the problems of interference along the border of Thailand and its neighborhood.



**Figure 4** Guideline for the use of 700 MHz Spectrum and current situation in Thailand [8]

### 3. Frequency Band in 2500-2690 MHz

#### *a. Consideration from the frequency allocation by ITU*

ITU has set the frequency band 2500-2690 MHz for International Mobile Telecommunications (IMT) according to the agreement 223 (Rev.WRC-07). This allocation does not prohibit other services from using the abovementioned frequency band. In addition, it does not indicate any prioritization of the spectrum in the Radio Regulation (WRC-07).

#### *b. Current Situation*

The current NBTC's spectrum master plan has set the band 2500-2690 MHz for the telecommunication service. In the past, it was assigned to the government agencies, especially the Government Public Relations Department and MCOT Public Company Limited (previously known as Mass Communication Organization of Thailand). Considering technology development together with number of assigned frequency, their use has not been quite efficient. Additionally, it does not get along with the growing demand for spectrum.

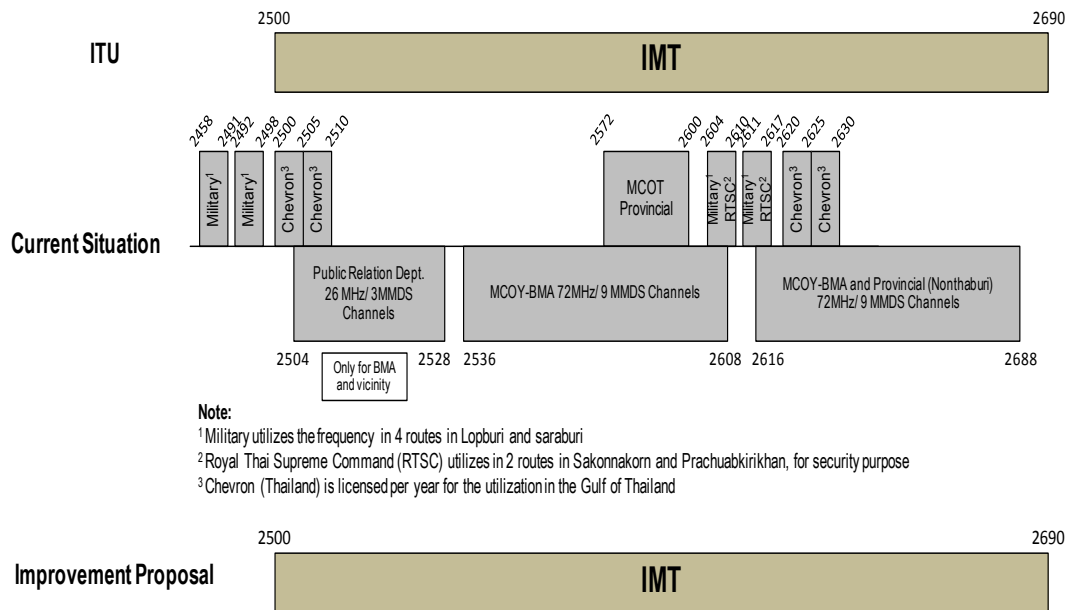
#### *c. Main Factors Effecting the Utilization*

The important characteristic of this frequency band is its ability to propagate well through physical obstructions. It is fit to the use in a highly populated area of users and geographically not in a big area. Presently, there are many devices operating in this band, many countries therefore assign this frequency band to enhance efficiency the high-speed wireless broadband service.

#### *d. Proposal for Improvement*

Propose to assign the band 2500-2690 MHz for the IMT service.





**Figure 5** Guideline for the use of 2500-2690 MHz Spectrum and current situation in Thailand [8]

#### 4. Exempted Spectrum (Unlicensed)

In order to serve huge amount of data of mobile phone networks in a highly populated area of users, it is necessary to use other technologies to support such a density of traffic – WiFi 2.4 GHz and 5 GHz, and perhaps the concept of Whitespace.

In Thailand, it is allowed to use the frequency band 2.4 GHz and 5 GHz (exempted and unlicensed), according to the National Telecommunications Commission's announcement with the subject of the unlicensed radiocommunication device and radiocommunication station and the announcement with the subject of the use of radio frequency for short range devices at 5 GHz. Such unlicensed limits the transmitting power as details below:

**Table 1** Unlicensed limits the transmitting power

Frequency Spectrum	Transmitting Power (e.i.r.p.) (Equivalent Isotropically Radiated Power)
2400 – 2500 MHz	0.1 Watt
5150 – 5350 MHz	0.2 Watt
5470 – 5725 MHz	1.0 Watt
5725 – 5850 MHz	1.0 Watt

For the concept of Whitespace, it is to use any unused frequency channel, assigned for the television service to transfer huge amount of data of the mobile service. This concept has just been deployed in USA. In many countries, it is being study.

In this regard, it is agreed that there should be a study if it is appropriate to use the concept of Whitespace in Thailand.

## 5. FUTURE TRENDS IN MOBILE MARKET

As the capacity for mobile communication technologies has been improved and brought about new solutions to the market, the technology vendors and producers who have been telecommunications industry leaders tend to develop and transform themselves into HetNet solution adopters so as to fill up coverage gaps and perfectly capture the industry's market share from the midstream to downstream. In the near future, we will see the HetNet network growing in all regions of the world. According to the Markets and Markets' research report, it is pointed out that the compound annual growth rate of HetNets markets (CAGR%) over a period of 6 years, from 2012-2018, stands at 62 percent with the market value worth 16 billion USD by 2018. Such growth is strong and considered a clear trend for operators to make investments in HetNet solutions as well [10].

When classifying market values and growth rates of small cells into various categories, it is also found that the growth rate in each category is rather tremendously high. That is, the compound annual growth rates (CAGR%) of Femtocells, Picocells, and Microcells over a period of 6 years, from 2012-2018, stand at 86.29, 88.67, and 66.44 percent, respectively and the total market value of these 3 categories is worth not less than 10,300 million USD by 2018.

Besides, when taking the possibly arising marketing opportunities into consideration, the installation and allocation of small cells also provide mobile operators with more opportunities in the future as follows:

- Give rise to a new business model under the name of "Small Cells as a Service (SCaaS)". This particular model will allow a new group of service providers to freely install and allocate small cells in the market and directly present management and connection solutions to mobile operators. This will lower mobile operators' risks in terms of costs, long-term network management, home backhaul connections, etc.
- Give rise to the opportunity for increasing the added value of services or marketing opportunities, especially in a specific area where small cells are installed. This is due to the fact that such convenient installation can increase or decrease the number of devices used and enable more flexible management compared to macro cells deployment.
- Save costs and consume less power because mobile operators may choose to make investments to install small cells only in specific areas with high population densities or the area with limitations to geography and city distribution. Here, some small cells (femto-/pico-) can be removed to be temporary installed for other specific purposes compared with the investment made in macro cells: the large-size nodes which require more installation areas, have more power consumption rates and limited flexibility in increase and reduction of bandwidth and service channels. In Thailand, particularly, when a large base station tower is constructed, there might be some analytical issues concerning environmental impact assessment or EIA and social attitudes in specific areas affecting investment duration and investment budget (another advantage of small cells is that some of them have very low transmitting power ranged from 10mW to 1W, but are still able to provide services within the radius of 100-300 meters).
- Lessen burdens and increase efficiency in data offloading management because small cells and Wi-Fi can be integrated into small solutions for being installed in areas with high data utilization demands.

### The Trend of Data Communication Network Technology

- The widespread establishment of hybrid network solutions or HetNets will become the standard pattern for investment and installation.
- There will be rising growth and investment demands for small cells in every category (Micro cells, Pinocells, and Femtocells, etc.) in the area with specific features and high rates of bandwidth consumption.
- The widespread installation of Wi-Fi access points (both in the form of HotSpot 2.0 and I-WLAN) and the integrated installation (in the level of carrier) will inevitably become basic services in the future.

### The Trend of Roadmaps for Generations of Mobile Telecommunications Technology

- eNodeB/ LTE in the form of Macro cells and Micro cells
- 4G LTE services will be operated in various frequencies such as 1800 MHz and 2600 MHz, in the FDD mode which provides a larger capacity than the 700 MHz frequency band and WCDMA-HSPA.

## 6. CONCLUSION

The technology development, user behavior and the changing of business landscape has set an expectation to an increase demand for spectrum of high speed wireless broadband service. With the reason, International organizations and international guidelines has set to manage spectrum to ensure it sufficient to future demand by identified frequency spectrums for 4G service. For Thailand, mobile subscription penetration has surpassed 100% and the smartphone and tablets usage are continuously growing. This would lead to the concern of amount of spectrum may not be sufficient to the demand under the expected quality. With the reason, the Roadmap for Telecommunications Spectrum Management in Thailand is fundamentally needed in order to meet the demand in the future. At the same time, the roadmap set off the policy clarity to the service providers and investors. It supports them as supporting information in their long term business plan. In this paper, frequency bands that need to be considered, and improved their utilization to serve the high-speed wireless broadband service are categorized into four frequency bands; 1800 MHz, 700 MHz, 2600 MHz, and unlicensed band. Recent development of mobile services in Thailand is also explained.

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